

I CLAIM:

1. A combined thermoacoustic heat engine and electrical generator comprising:
 - a) a thermally conductive envelopment means, a housing, for containing a compressible working fluid,
 - 5 b) said compressible working fluid being capable of supporting propagation of periodic acoustical traveling waves,
 - c) in a first section of the housing, a combination first heat exchanger means and acoustic traveling wave guiding means, a first heat exchanger-waveguide means, for admitting thermal energy to the compressible working fluid and vectoring acoustic traveling waves moving through
 - 10 said compressible working fluid,
 - d) in a second section of the housing, a second heat exchanger means for removing thermal energy from said compressible working fluid,
 - e) a thermal insulating means dividing said first and second sections of said housing, and said first heat exchanger-waveguide means and second heat exchanger means contained respectively
 - 15 therein, with ported openings that permit communication of the compressible working fluid between said first and second heat exchanger means,
 - f) an acoustical traveling wave generating means for causing periodic acoustical traveling waves to propagate on a path through the compressible working fluid in communication between said first heat exchanger-waveguide means and second heat exchanger means,
 - 20 g) an acoustical traveling wave driven means for converting periodic acoustical traveling waves into mechanical kinetic energy,
 - h) an energy conversion means for converting said mechanical kinetic energy into electrical energy,
 - i) a metering means for admitting and regulating a flow of heated, high pressure working fluid
 - 25 from said first heat exchanger-waveguide means and said acoustical traveling wave driven means, into said second heat exchanger means,
 - j) a first check valve means for causing the admittance of cooler working fluid from said second heat exchanger means into the acoustical traveling wave generating means, thereby completing an acoustic and thermodynamic circuit in the working fluid,

k) a second check valve means to prevent acoustic traveling waves from being reflected back into said acoustical traveling wave generating means from the first heat exchanger-waveguide means.

2. The heat engine as claimed in Claim 1, combining an acoustic wave guiding means, a wave-guide, as an integral unit with the first heat exchanger means, a first heat exchanger-
5 waveguide means, by means of which the periodic acoustical traveling waves are vectored, thermally amplified, and acoustic-impedance-controlled.

10 3. The heat engine as claimed in Claim 1, in which said first heat exchanger-waveguide means is a thermal conductor in communication with the external environment and the internal working fluid for the purpose of transmitting thermal energy between said external environment and said internal working fluid.

15 4. The heat engine as claimed in Claim 1, in which the thermal insulating means divides the thermally conductive envelopment means into two separate sections which, in conjunction with said thermal insulating means, with said first heat exchanger-waveguide means in one section, said second heat exchanger means in another section, and said thermal insulating means disposed between the sections, impede short-circuit thermal conduction between said first heat exchanger-waveguide means and said second heat exchanger means.

20 5. The heat engine as claimed in Claim 1 or Claim 4, in which the thermal insulating means is penetrated by a multiplicity of through holes, ports, through which the energy of the periodic acoustical traveling waves is caused to communicate between said first heat exchanger-waveguide means and said second heat exchanger means via the compressible working fluid.

25 6. The heat engine as claimed in Claim 1, in which said acoustical wave generating means, comprising a diaphragm spring piston, is affixed to the armature shaft and so disposed as to cause periodic acoustic traveling waves to propagate on a path through the compressible working fluid from said first heat exchanger-waveguide means to said second heat exchanger means, when the armature reciprocates.

7. The heat engine as claimed in Claim 1, in which said periodic acoustical traveling waves are caused to propagate through the compressible working fluid in contact with the internal wall of the first heat exchanger-waveguide means, which is typically at a higher temperature than said compressible working fluid, thereby causing an exchange of thermal energy between said first

heat exchanger-waveguide means and said compressible working fluid, causing said periodic acoustical traveling waves which are transiting said compressible working fluid to be amplified in pressure and temperature, thereby increasing the work function of said periodic acoustical traveling waves, and by these means converting thermal energy to acoustic energy.

5 8. The heat engine as claimed in Claim 1 or Claim 7, in which the periodic acoustical traveling waves disturb the laminar boundary conditions existing at the interface between the working fluid and the internal wall of the first heat exchanger-waveguide means, causing a periodic change in the rate of thermal energy flow between said first heat exchanger-waveguide means and said working fluid.

10 9. The heat engine as claimed in Claim 1 or Claim 8, in which thermal energy is injected into the periodic acoustical traveling waves via the first heat exchanger-waveguide means in order to amplify the temperature and pressure gradients of said periodic acoustical traveling waves with respect to the static working fluid through which they are propagating.

15 10. The heat engine as claimed in claim 1, in which said first heat exchanger-waveguide means and said second heat exchanger means have properties that have been manipulated, by means of engineering craft and process, so as to regulate the rate and periodicity of flow of thermal energy to and from the working fluid, said properties being specific heat, sensible heat, latent heat, thermal conductivity, cross-sectional thickness, contact surface area and mass.

20 11. The heat engine as claimed in claim 1, or claim 10, in which the first heat exchanger-waveguide means and second heat exchanger means are further characterized by a property of thermal and acoustic resonance that is manipulated so as to cause said first heat exchanger-waveguide means and said second heat exchanger means to couple thermodynamically most efficiently with periodic acoustical traveling waves of a given frequency, and less efficiently 25 with the static working fluid through which said periodic acoustical traveling waves are propagating, the coupling efficiency directly affecting the rate of thermal energy transferred per unit time between said first heat exchanger-waveguide means and said second heat exchanger means and the working fluid.

12. The heat engine as claimed in claim 1, in which the cross-sectional area of the first heat exchanger-waveguide means increases in the direction of wave propagation, the geometric flare of said first heat exchanger-waveguide means causing the periodic acoustical traveling waves to be vectored from said first heat exchanger-waveguide means to the acoustic wave driven means

5 by controlling the acoustic path impedance so that one direction of acoustic wave propagation is favored, and further causes the propagation velocity and amplitude of said periodic acoustical traveling waves to be increased by injection of thermal energy into the working fluid, said amplitude being defined as the pressure-temperature gradient of said periodic acoustical traveling waves with respect to the static working fluid.

10 13. The heat engine as claimed in claim 1, in which the energy conversion means is a linear alternator, comprised of spring diaphragm pistons which support an armature assembly so that it is capable of reciprocating motion, in combination with a magnetic field generating means, an induction winding for conveying current from said linear alternator to an external load, and electrical pole pieces so disposed in relation to the armature that when said spring diaphragm

15 pistons and armature assembly is caused to reciprocate by means of a fluctuating pressure gradient in the form of periodic acoustical traveling waves acting upon the spring diaphragm piston driven means, said linear alternator produces alternating electrical current.

14. The heat engine as claimed in claim 1 or claim 13, in which the piston-armature assembly of the energy conversion means is comprised of an armature shaft, having at a point

20 along the axis of said armature shaft an enlarged diameter section perpendicular in plane to the axis of said armature shaft, said enlarged diameter section having a multiplicity of electrically conductive and magnetically conductive shorting rings affixed to the periphery of said enlarged diameter section and oriented along the same plane as said enlarged diameter section so as to form an electromagnetically inductive shorting ring assembly around the armature shaft.

25 15. The heat engine as claimed in claim 1, in which the armature shaft of the energy conversion means is suspended at one end by a first flexible spring diaphragm piston means, and at the opposite end by a second flexible spring diaphragm piston means, said first flexible spring diaphragm piston means comprising the acoustic wave generating means, and the second flexible spring diaphragm piston means comprising the acoustic wave driven means, said acoustic wave

generating means and said acoustic wave driven means being coupled together mechanically via said armature shaft, and coupled acoustically via an acoustic path that communicates between said acoustic wave generating means, the first heat exchanger-waveguide means and the acoustic wave driven means.

5 16. The heat engine as claimed in claim 1 or claim 15, in which the acoustic wave generating means communicates with the acoustic wave driven means by means of acoustic traveling waves.

10 17. The heat engine as claimed in claim 1, in which the first heat exchanger-waveguide means comprises an acoustic delay line, said acoustic delay line being well known to acoustics engineering science, which in conjunction with the properties of the compressible working fluid and thermal gradient, controls the resonant period of the acoustical traveling waves which are propagating between the acoustic wave generating means and the acoustic wave driven means.

15 18. The heat engine as claimed in claim 1, in which the metering means is disposed between said acoustic wave driven means and the second heat exchanger means so as to cause the periodic acoustical traveling waves to slow and stall in the vicinity of the acoustic wave driven means, thereby giving up energy of inertial moment and causing periodic pressure-temperature peaks that mimic Stirling Cycle compressions in the working fluid.

20 19. The heat engine as claimed in claim 1, or claim 18, in which the metering means meters the acoustical and thermal energy in the stalled periodic acoustical traveling waves into said second heat exchanger means, where thermal energy is extracted from the working fluid and transmitted, via conduction, through the second heat exchanger means to an external heat sink.

25 20. A combined thermoacoustic heat engine and electrical generator whereby thermal energy is converted to useful work via temperature-pressure amplification of periodic acoustic traveling waves in a compressible working fluid which cause the armature of a linear alternator to reciprocate and produce alternating current electrical energy.